

Comparison of HALOE and MLS HCl with Calculated Time Series from Several Photochemical Models

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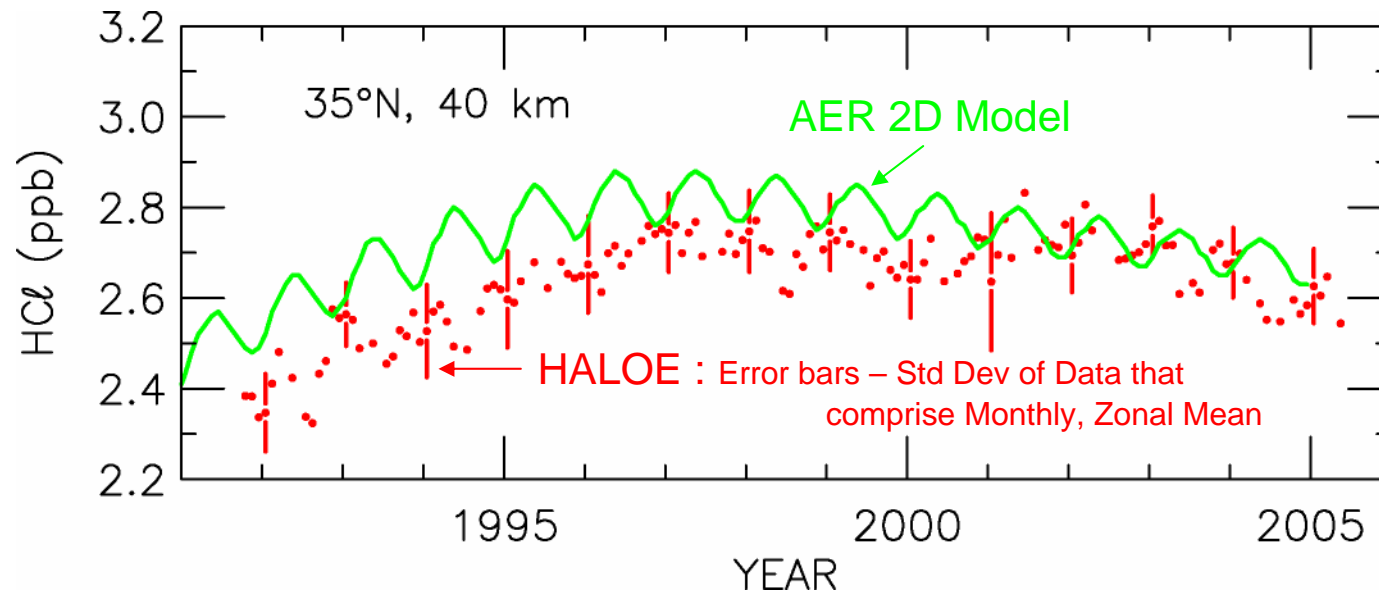
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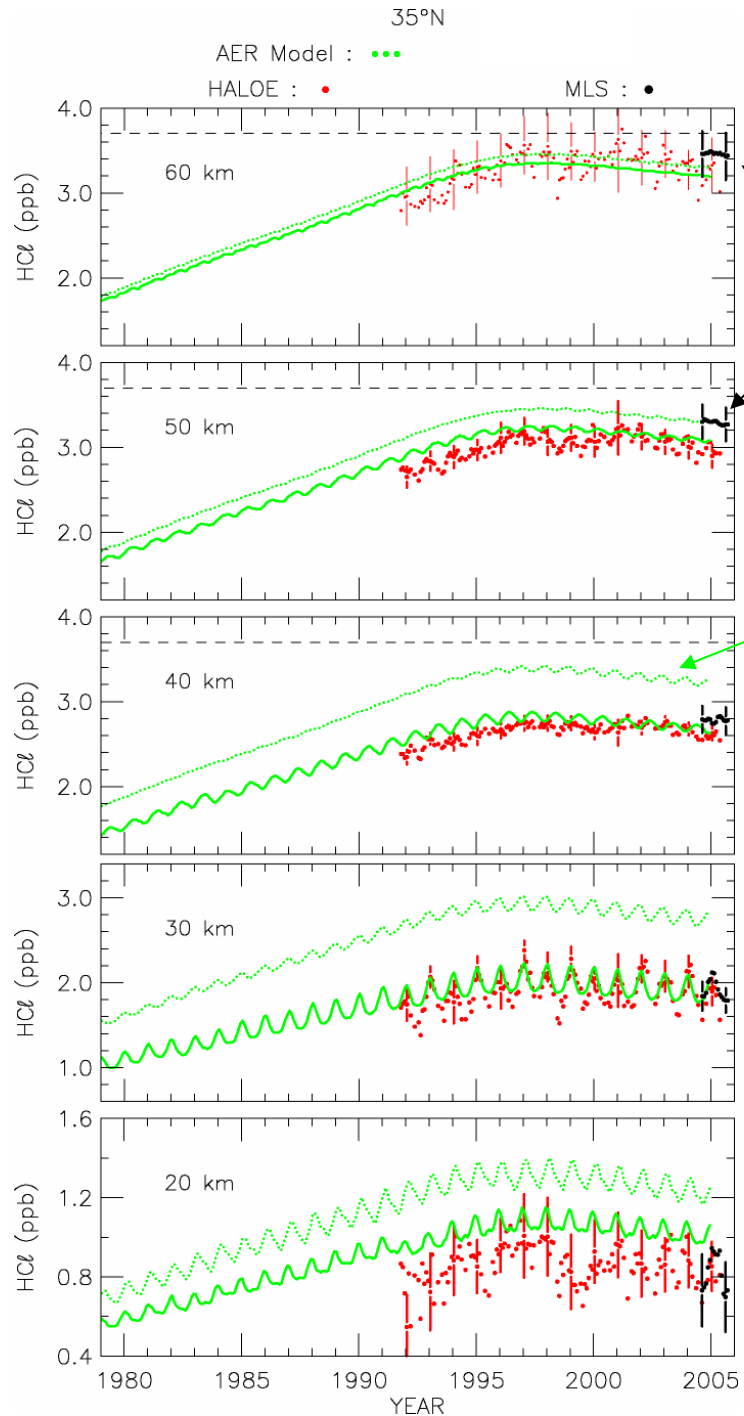
Motivation



- Zonal, monthly mean HALOE HCl agrees fairly well with this 2D model calculation, particularly at the end of the time series
- Model run: “AER” transport
Similar to AER model run shown in WMO 2002 (Orange Book)
- Focus on:

Factors that govern this comparison

Aura MLS HCl



Aura MLS HCI

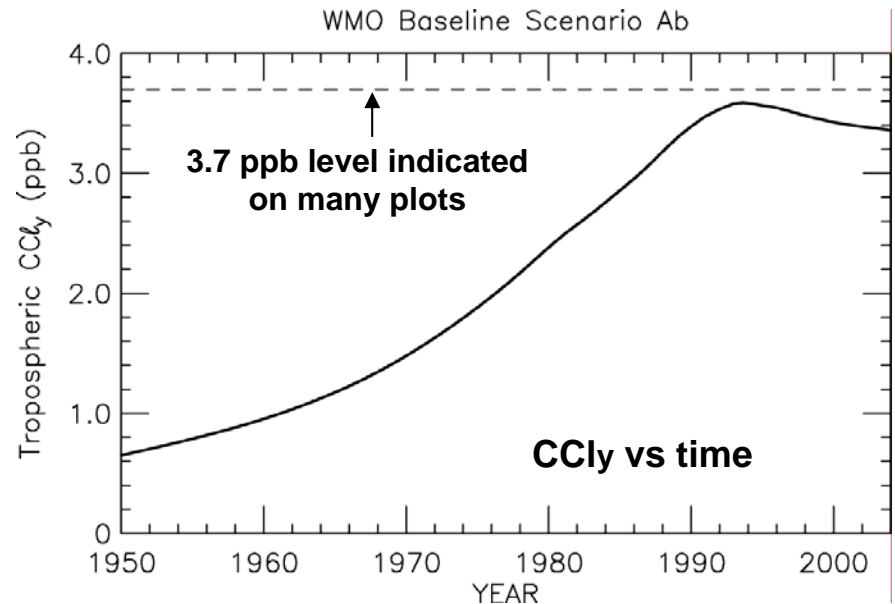
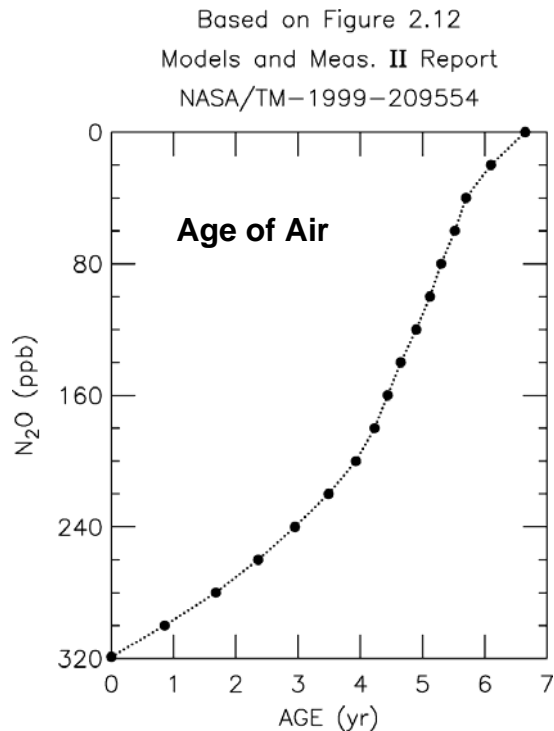
Error bars – Std Dev of Data in Monthly, Zonal Mean

NOTE: Uncertainty in MLS zonal, monthly mean is
5-6 times better (Froidevaux talk)

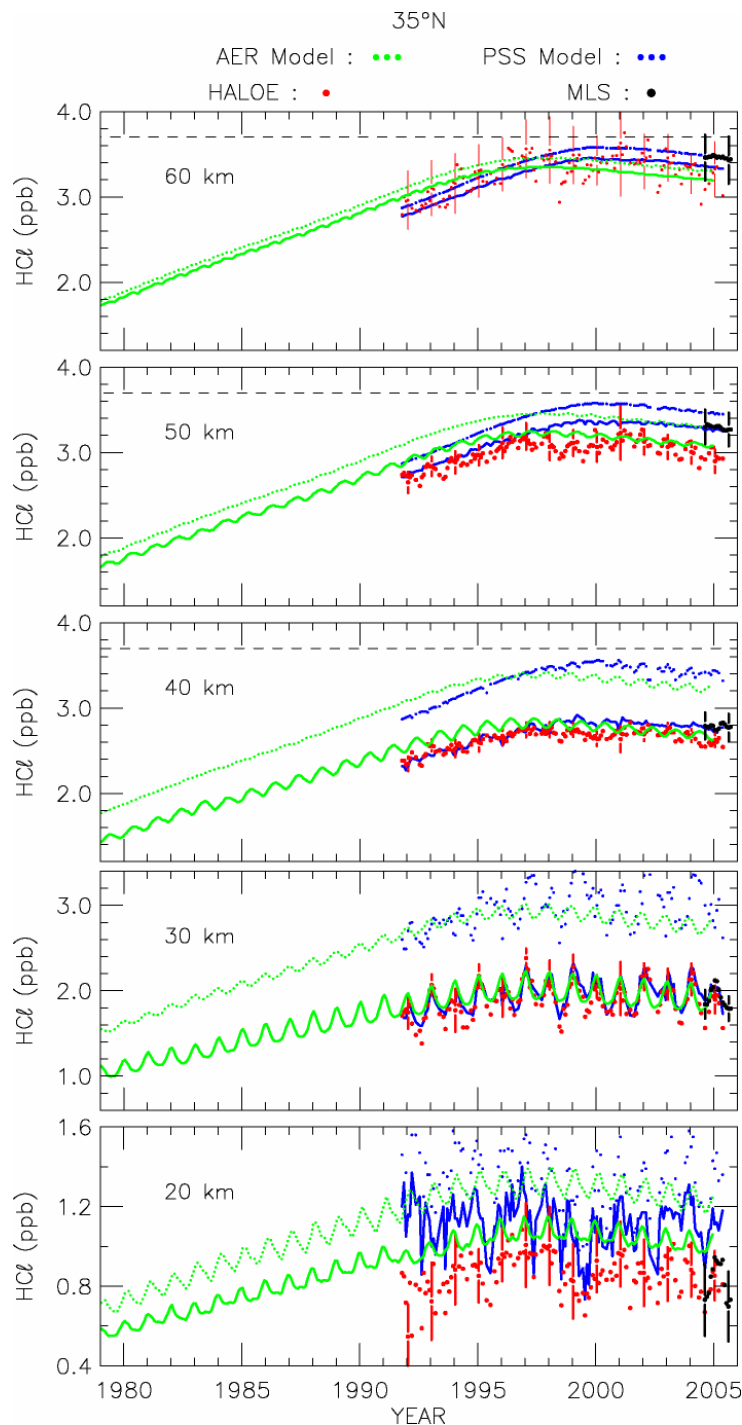
Cly DOTTED UPPER LINES
ON ALL PANELS

PSS (Photochemical Steady State) Model

- HALOE CH_4 used to calculate N_2O (Michelsen *et al.*, *GRL*, 1998)
- Cl_y and NO_y estimated from N_2O using standard correlations
- O_3 , Surface Area, H_2O , etc from HALOE and SAGE II
- $d\text{N}_2\text{O}/dt$, $d\text{CH}_4/dt$, Age of Air, and CCl_y vs time considered



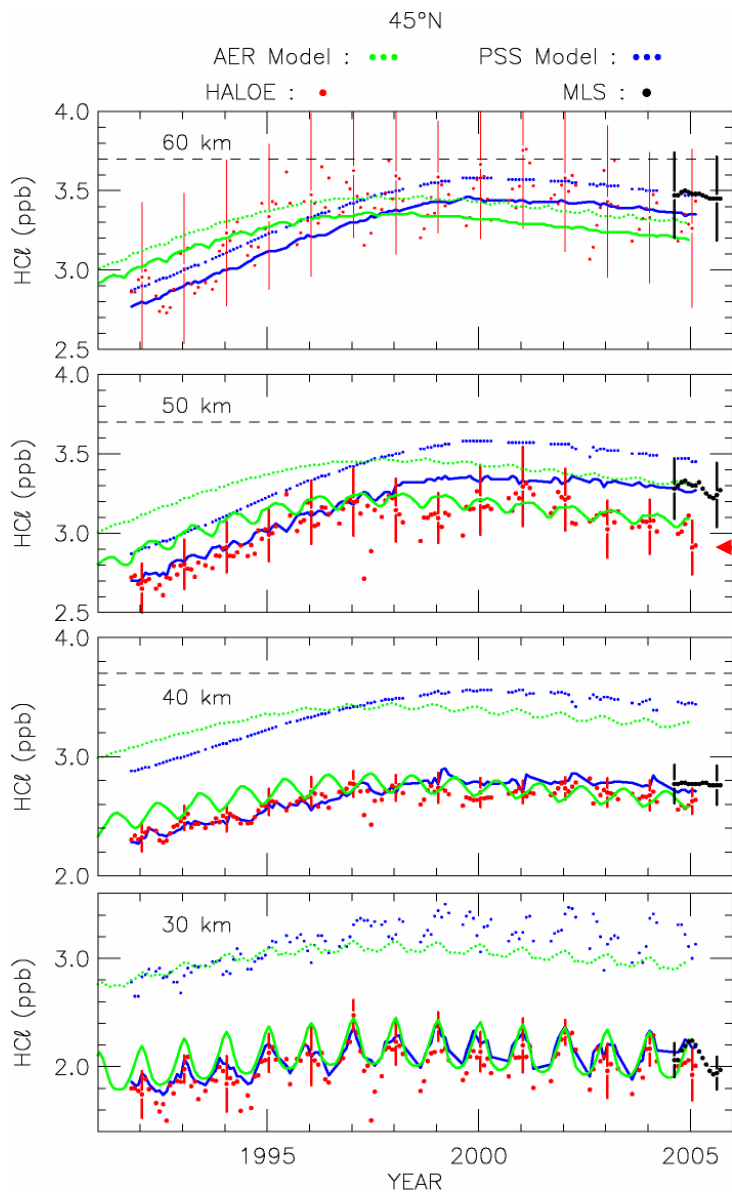
- Modeling approach developed originally to analyze aircraft data
- Applied recently to satellite data for “ozone trend attribution” calculations (Yang *et al.*, *JGR*, submitted, 2005)



- PSS HCl > AER HCl
- HCl differences driven by Cl_y
- Timing of Cl_y , and peak Cl_y , differ
- PSS results depend on accuracy and precision of HALOE CH_4
 \Rightarrow differences at 20 km probably driven by uncertainty in CH_4

Other plots in talk:

- Drop 20 km
- Focus on UARS time period (1991 to present)

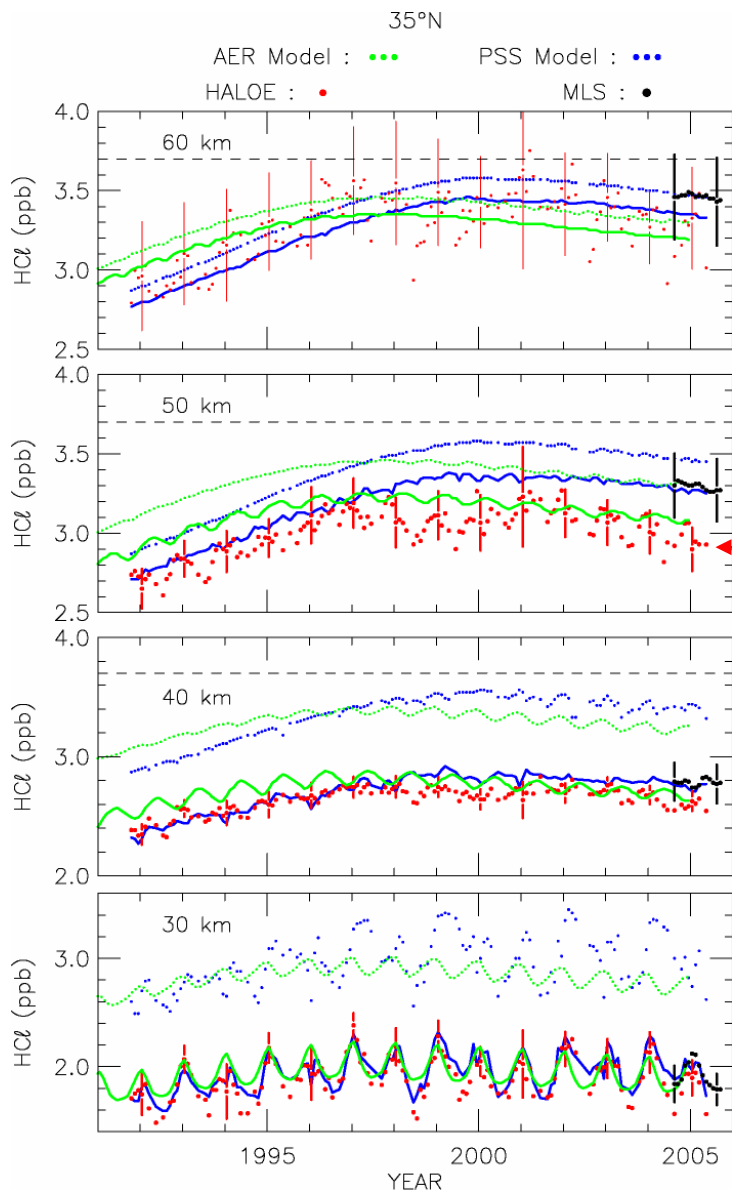


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UARS HALOE HCl

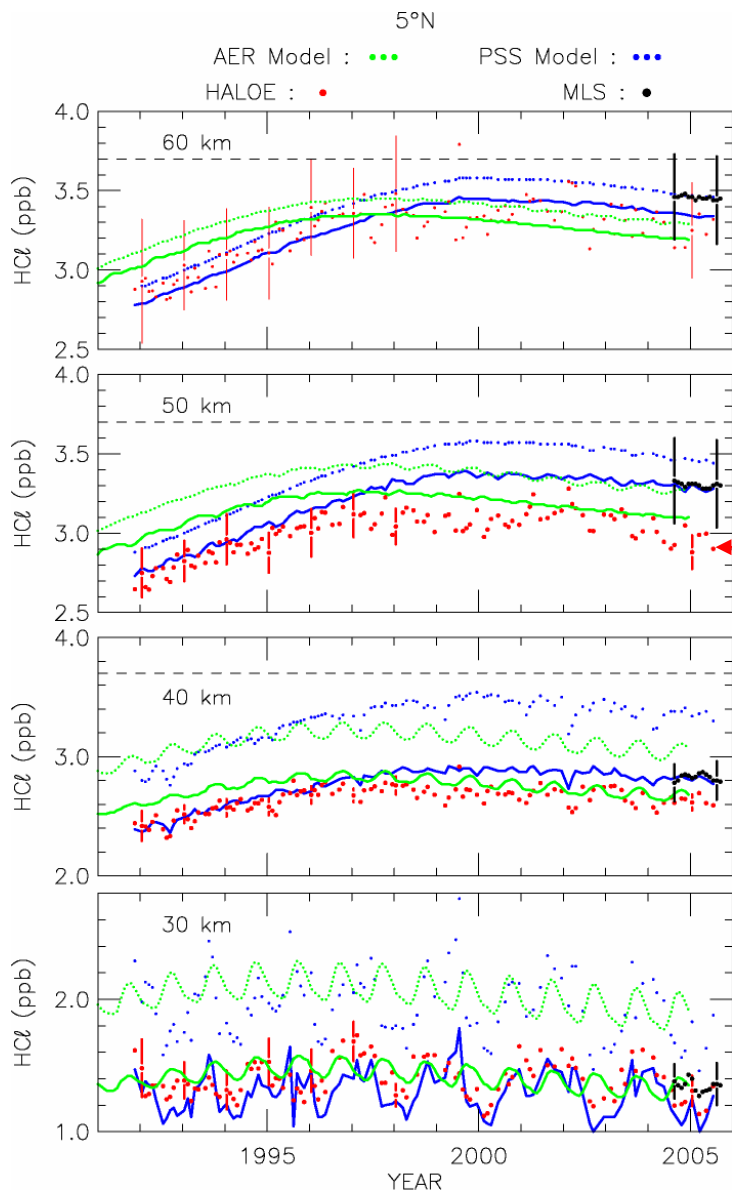


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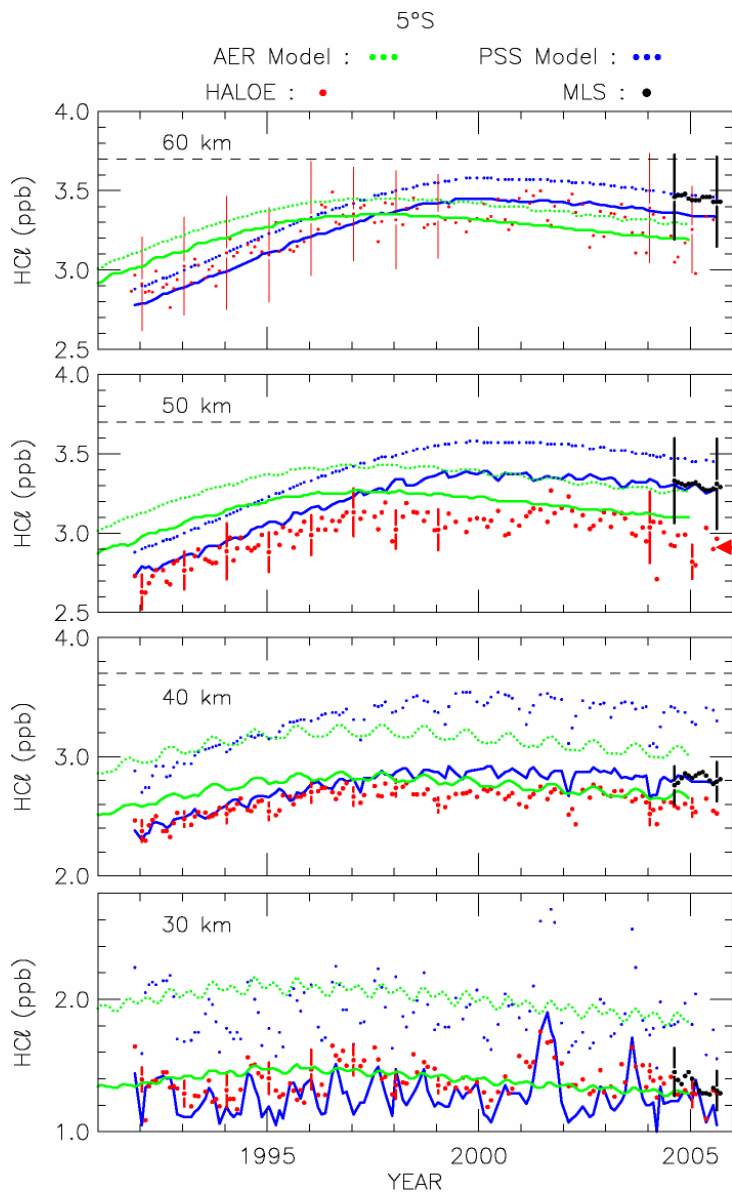


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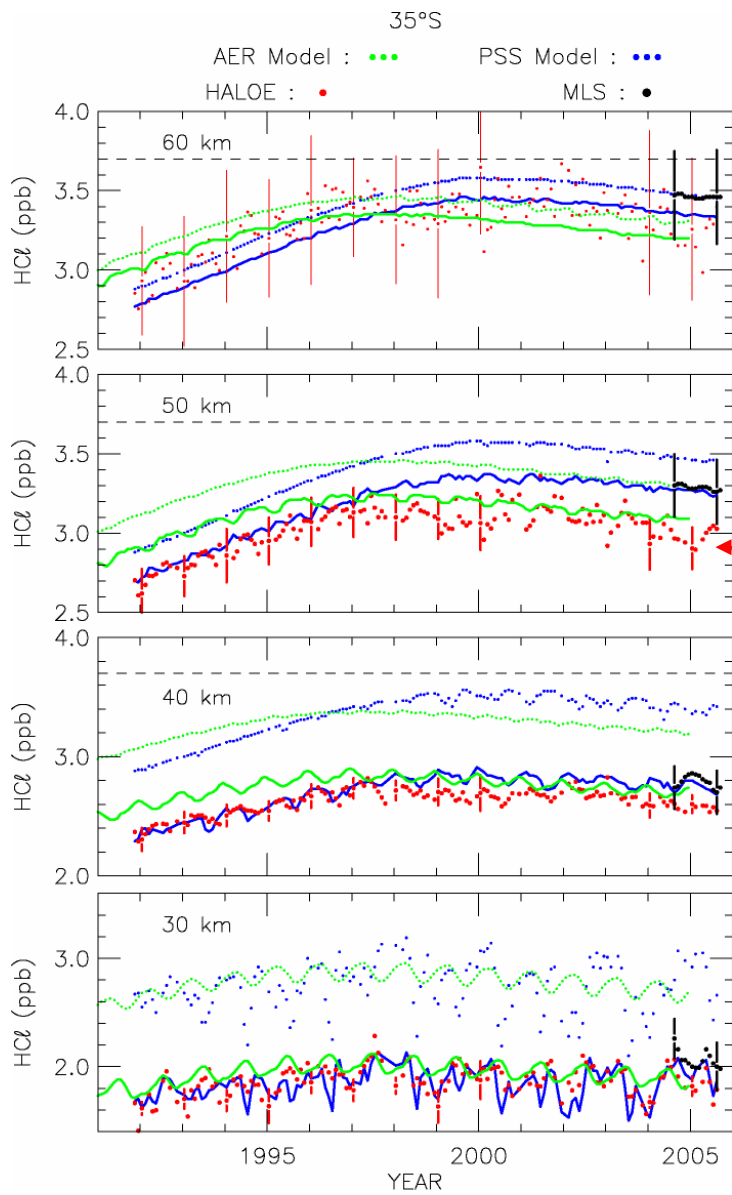


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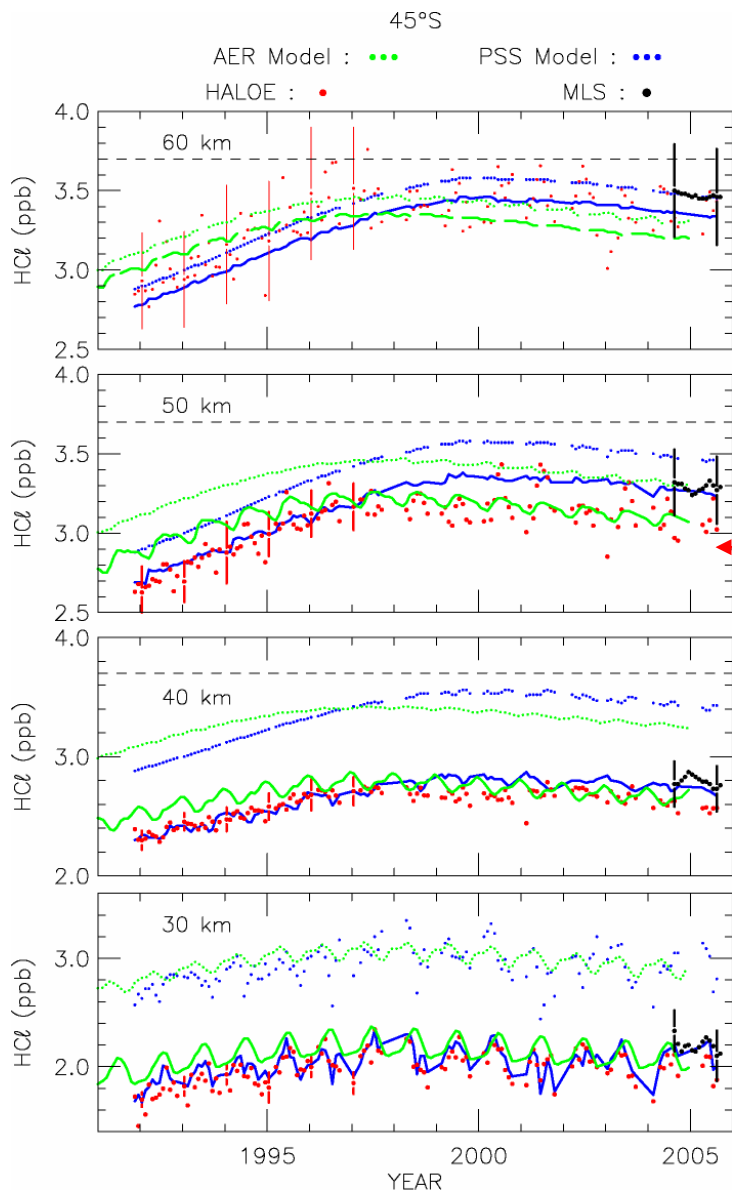


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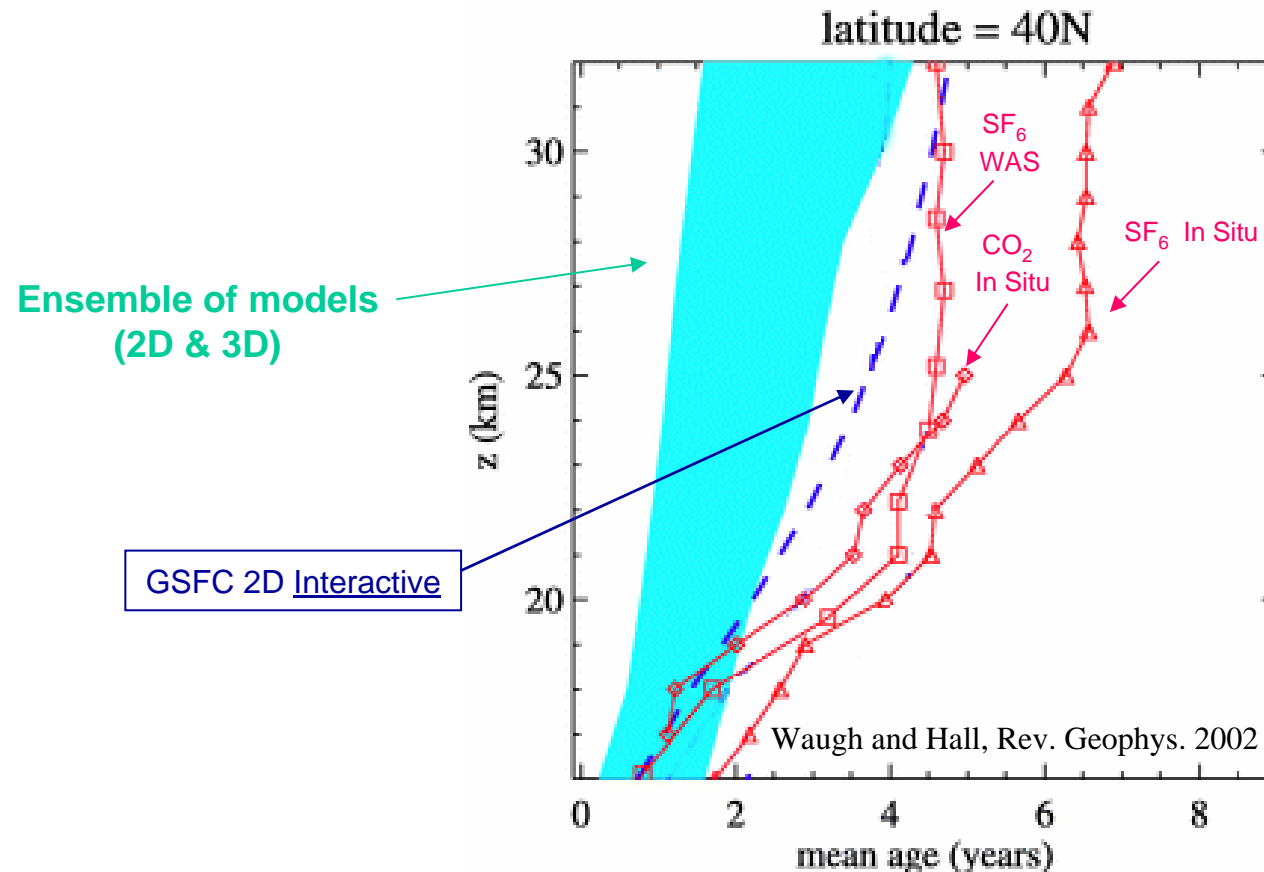
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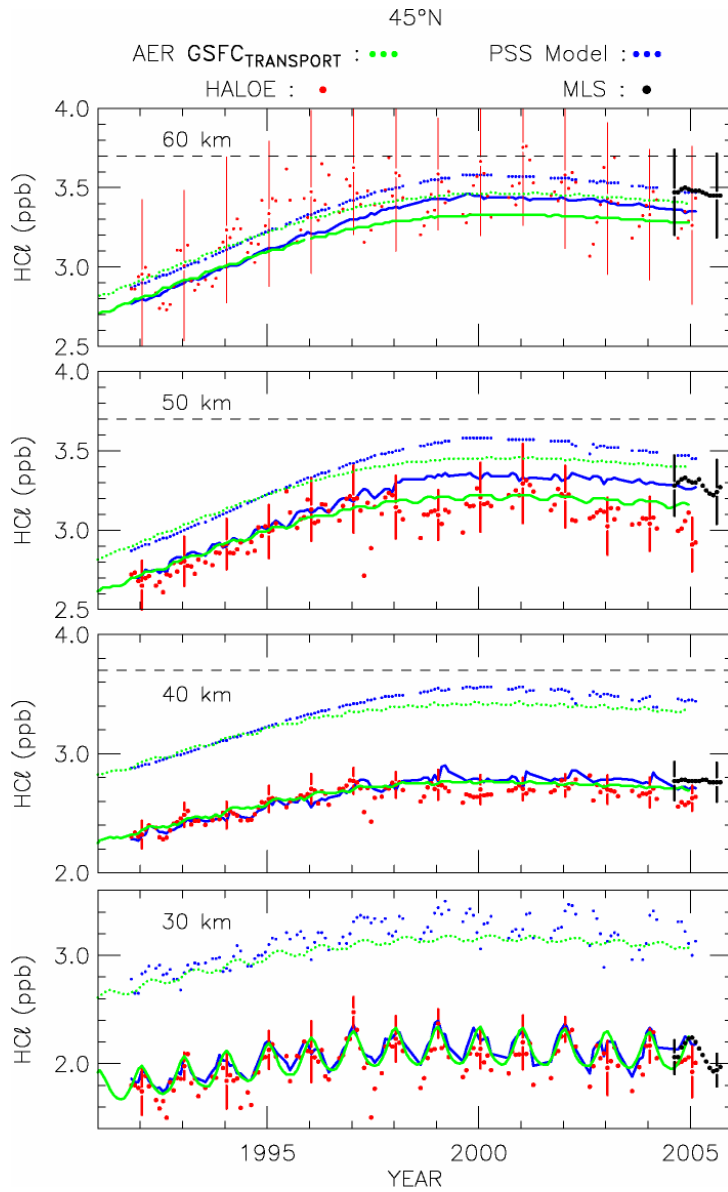
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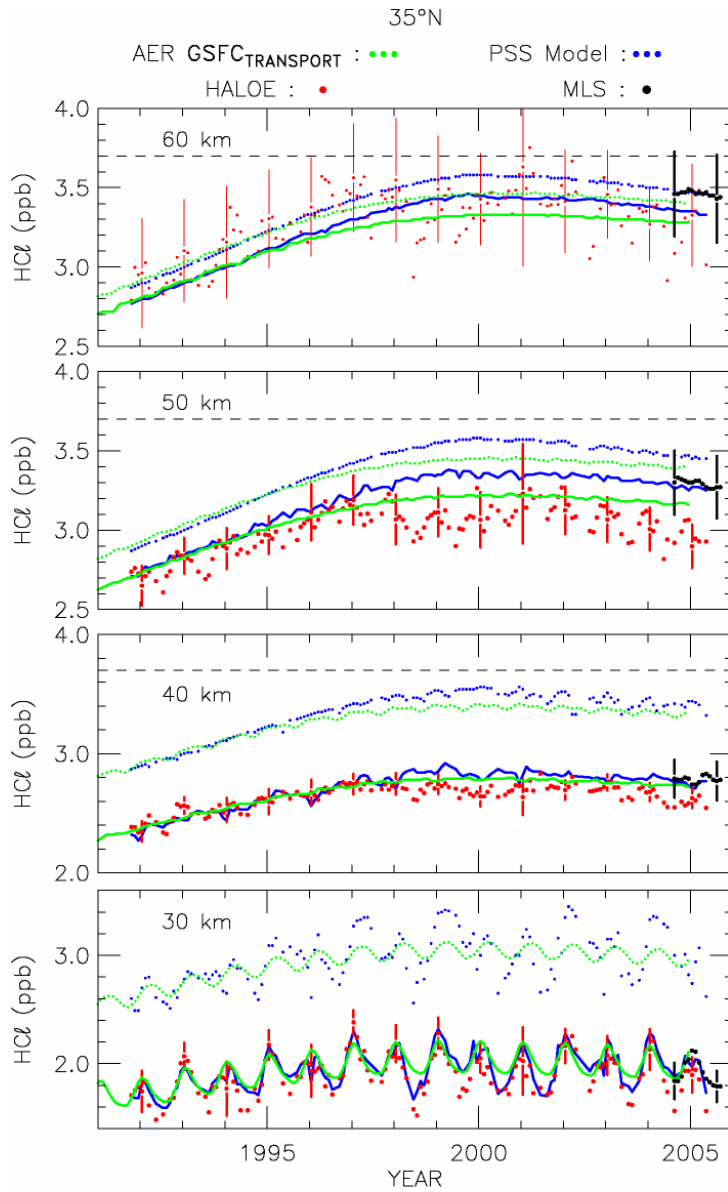
Second AER Model Run

- Age of air in most models “too young” compared to empirical estimates (e.g., Waugh and Hall, 2002)
- We’ll examine another AER 2D model run, using GSFC transport
 - GSFC non-interactive based on observed climatology of T, O₃, H₂O, etc
 - yields larger “age of air” than AER transport
 - Jackman *et al.*, *JGR*, 1996; Fleming *et al.*, *JGR*, 1999; Rinsland *et al.*, *JGR*, 2003

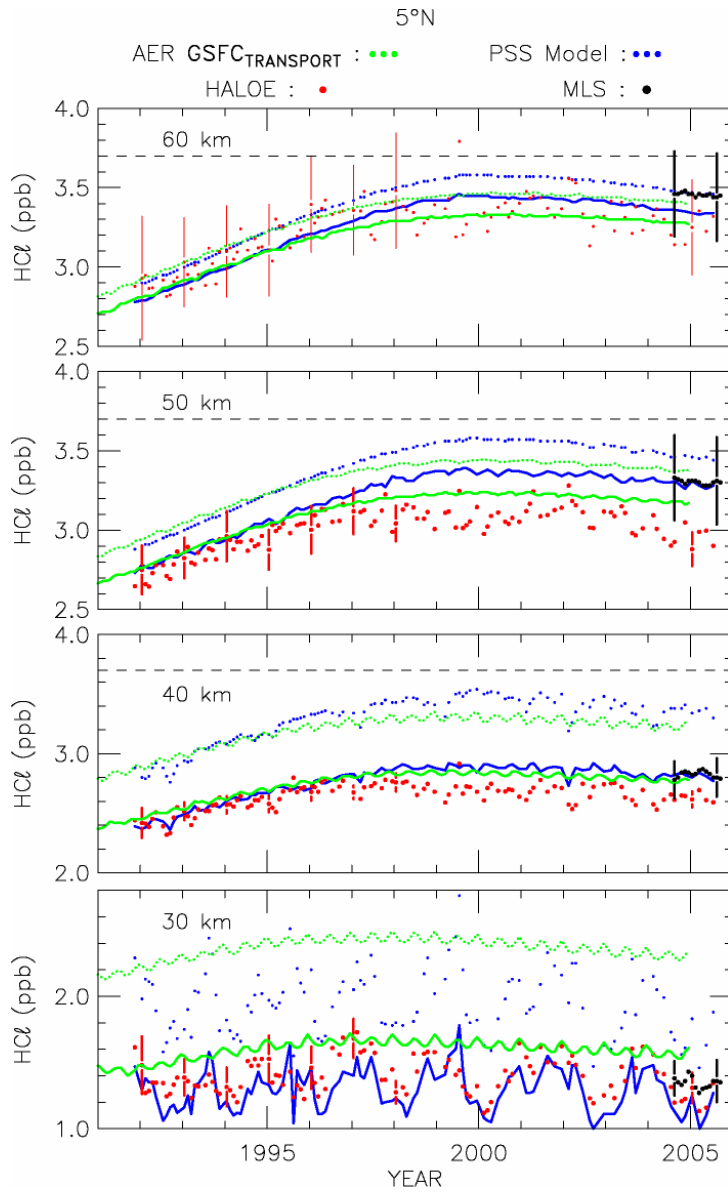




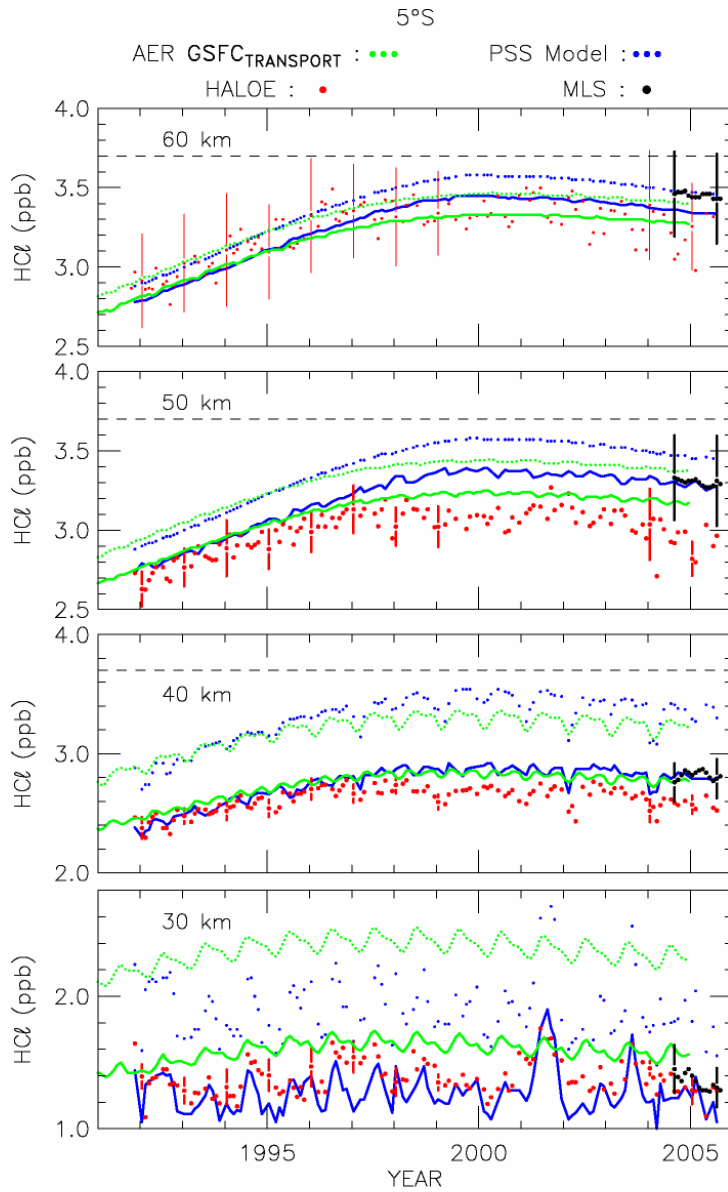
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- Differences in Cly after 1999 drive model HCl
- PSS model agrees with “early HALOE” and recent Aura MLS, esp. at 40 and 50 km
- AER model / GSFC transport agrees with “early HALOE”, splits diff between between current HALOE and Aura MLS



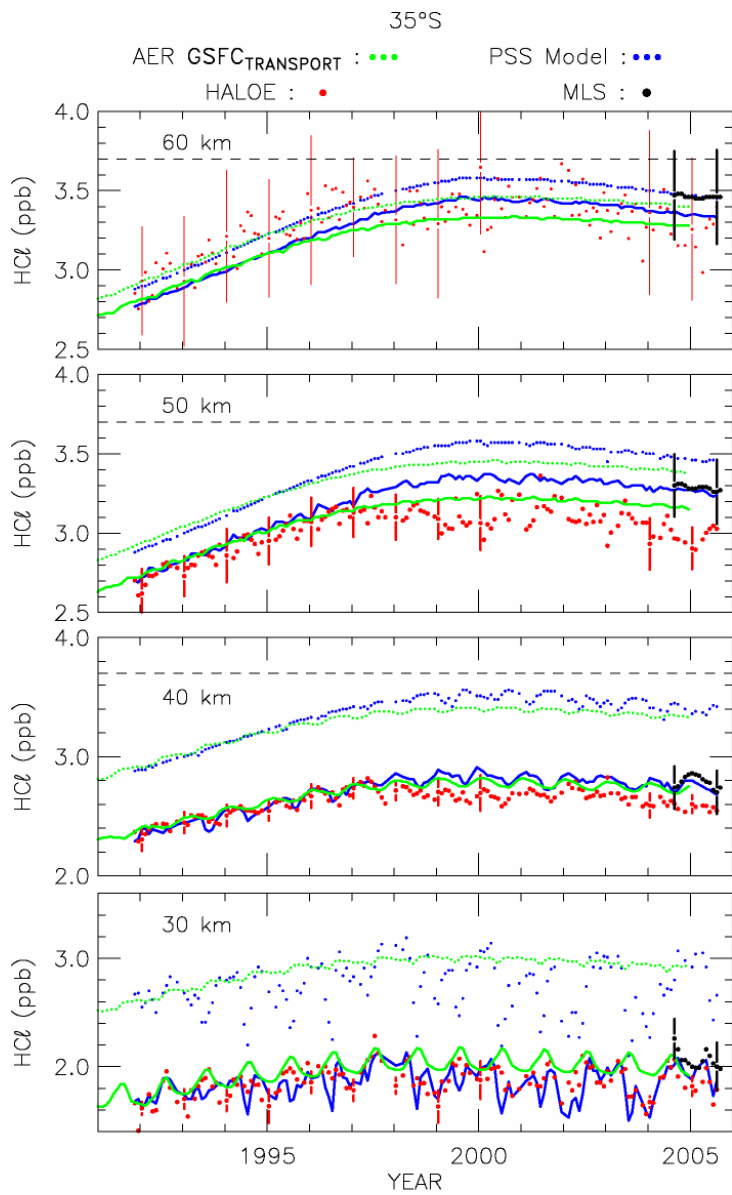
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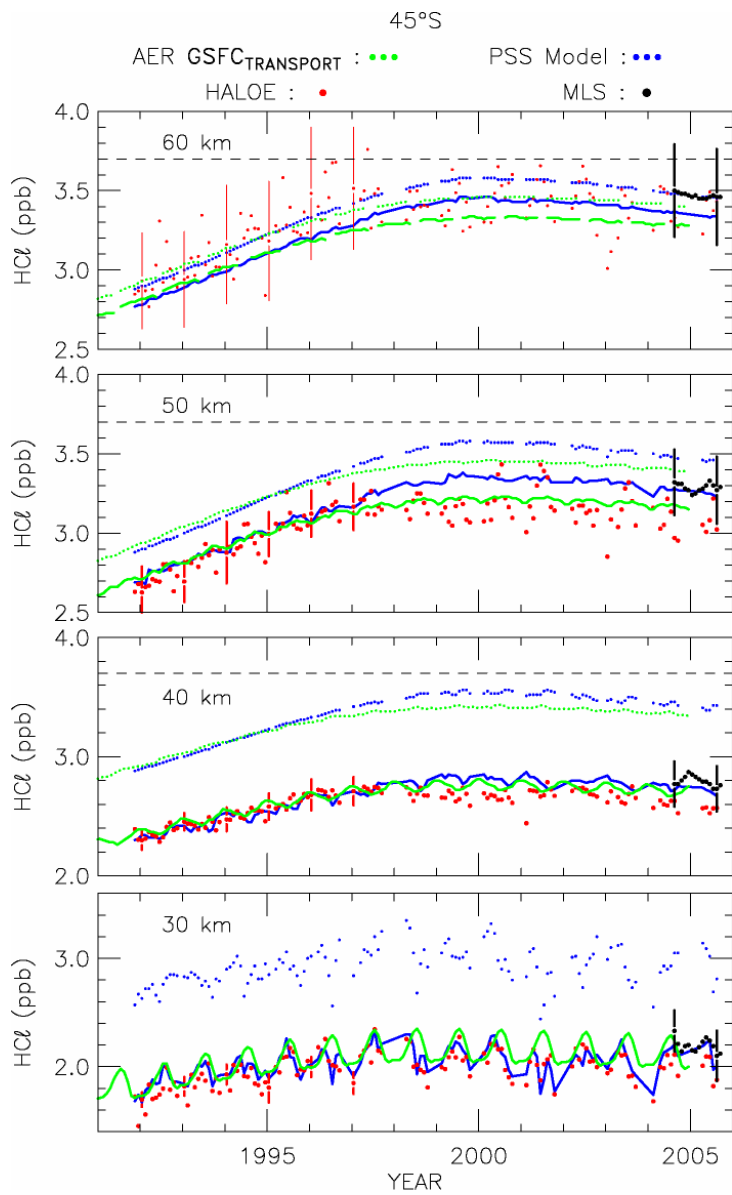
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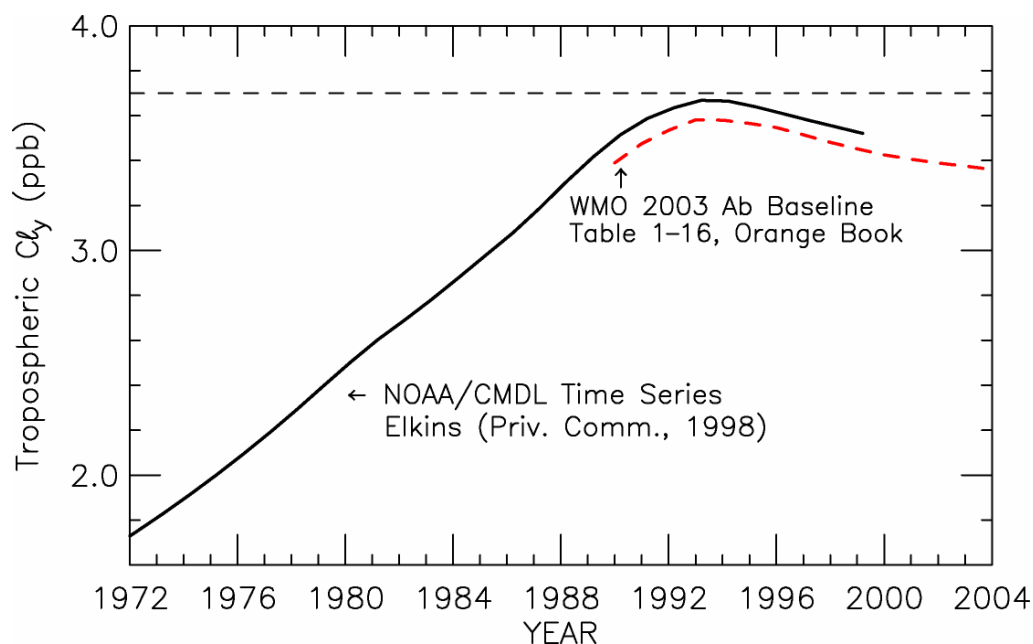


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- Model HCl above 30 km depends on:
 - age of air
 - CCly time series
- PSS model HCl agrees well with “early HALOE” and Aura MLS HCl
 - ⇒ Comparison of PSS w/ HALOE very similar to results in Waugh et al., *GRL*, 2001
- AER model / “AER transport” agrees best with “late HALOE”
- AER model / “GSFC transport” agrees with “early HALOE”, lies between recent HALOE and MLS

- Model HCl above 30 km depends on:
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 - CCl₄ time series
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⇒ What was the level of peak CCl₄ ???

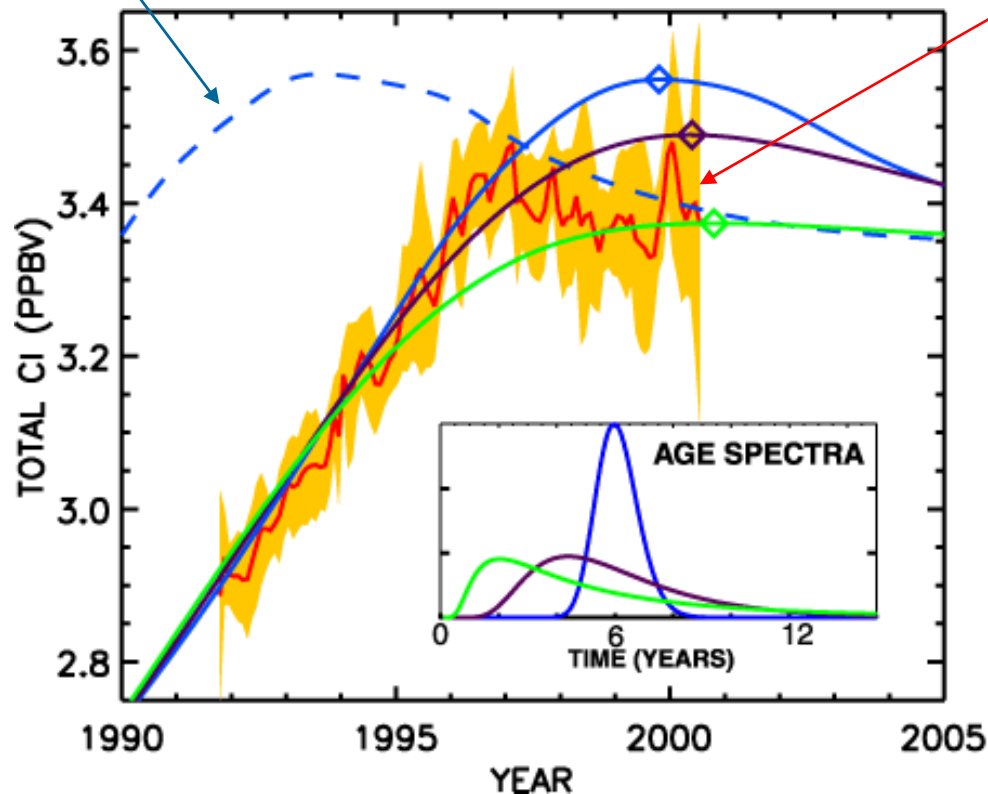


Backup Material To Follow

Waugh et al., GRL, 2001

Surface CCl₄

CCl₄ from HALOE HCl



Comparison of CCl₄ inferred from HALOE HCl, 0.46 mbar, with expected time series for CCl₄ with mean age of **6 years**, but various age spectra, as indicated.

Note: CCl₄ peaks just below 3.6 ppb in this analysis